

University of California San Francisco

Curriculum Vitae John Irwin, Ph.D.

Position Academic Coordinator III, Step 9 with a concurrent appointment as Assistant Adjunct Professor

Address: Dept. of Pharmaceutical Chemistry
University of California San Francisco
1700 4th St, BH501D Mailcode 2550
San Francisco CA 94143-2330

Voice 415 514 4127. Fax 415 514 4260. Cell 415 299 0957
e-mail: jjj@cgl.ucsf.edu
<http://johnirwin.compbio.ucsf.edu>

Citizenship Canadian, Born: 5/13/63 US Permanent resident

Education

1981-1985 University of Toronto
Bachelor of Science in Chemistry and Biochemistry

1986-1987 University of Toronto
Master of Science in Chemistry

1988-1991 Ph.D. in Organic Chemistry
Swiss Federal Institute of Technology
Advisor: Professor Jack D. Dunitz

Postdoctoral Research Training

1994-1998 MRC Laboratory of Molecular Biology, Cambridge England
Dr. Gerard Bricogne

Principal Positions Held

Oct 2004 – Present Adjunct Assistant Professor, Pharmaceutical Chemistry, UCSF
Jan 2004 – Sep 2004 Researcher, Pharmaceutical Chemistry, UCSF
Jul 2000 – Dec 2003 Senior Research Associate, Northwestern University Medical School
Department of Molecular Pharmacology and Biological Chemistry, Chicago IL.
Oct 1998 – Jun 2000 Staff Scientist, European Bioinformatics Institute, Cambridge, UK.
Jan - Sep 1998 Head of Information Technology at Global Phasing Ltd, Cambridge, UK.
Mar 1994 – Sept 1998 Staff Scientist, MRC Laboratory of Molecular Biology, Cambridge, UK.

Dec 1993 - Feb 1994 IT consultant at the Max Planck Institute for Molecular Physiology
Dortmund, Germany.
Feb 1991 - Jun 1993 Product Line Manager at Biostructure S.A., Strasbourg, France.
1985 Computer System Manager, Irwin Publishing Inc., Toronto, Canada.
1982-1984 Computer Programmer, I. P. Sharp Associates, Toronto, Canada.

Keywords/Areas of Interest: Structure based drug design, virtual screening, chemical databases, bioinformatics, chemical informatics.

Professional Activity

Memberships

2000-present American Chemical Society

Service to Professional Publications

2006- Section Editor for Cheminformatics and Molecular Modeling and member of the editorial advisory board, BMC Chemistry Central Journal (CCJ)
2004-2005 Ad hoc reviewer for *Acta Crystallographica* (1)
2000-2007 Ad hoc reviewer for *Journal Of Computer-Aided Molecular Design* (5)
2000-2007 Ad hoc reviewer for *Bioinformatics* (3)
2004-2008 Ad hoc reviewer for *J.Chem.Inf.Model. (was JCICS)* (9)
2005 Ad hoc reviewer for *Structure* (1)
2005 Ad hoc reviewer for *Molecular Simulation* (2)
2005 Ad hoc reviewer for *J. Biotechnology* (1)
2006 Ad hoc reviewer for *BMC Bioinformatics* (1)
2006-2007 Ad hoc reviewer for *J. Med. Chem.* (7)
2006 Ad hoc reviewer for *Drug Discovery Today* (1)
2007 Ad hoc reviewer for *Nucleic Acids Research* (1)
2007 Ad hoc reviewer for *Molecular Pharmaceutics* (1)
2007 Ad hoc reviewer for *Proceedings of the IEEE* (1)
2007 Ad hoc reviewer for *Bioorg. Med. Chem. Lett.* (1)

Invited Seminars (Total 37)

International (14)

14. International School of Crystallography, Erice, Italy. May 29 – June 8, 2008. “Virtual screening for non experts”

13. Pharmaceutical Sciences World Congress (PSWC), Amsterdam, The Netherlands, April 22-25, 2007. “Structure based virtual screening”.

12. University of Sao Paolo at Sao Carlos, Sao Carlos, Brazil. November 14, 2006. "Relating proteins by their ligands"
11. 3rd Brazilian Symposium on Medicinal Chemistry, Sao Paolo Brazil, November 11 2006. "How good in your virtual screening library?"
10. Gordon Research Conference on Combinatorial Chemistry, August 2006, Oxford, England. "ZINC: A public access library for HTS and virtual screening."
9. Society for Biomolecular Screening, 11th Annual Conference and Exhibition on Drug Discovery, Geneva, Switzerland, Sept 11-15, 2005 "The ZINC Database for vHTS and Focused Libraries"
8. Speaker and workshop instructor, Fourth European Workshop on Computer Aided Drug Design, May 25-June 1 2003. Siena Italy.
7. Workshop speaker and instructor, International School of Crystallography, Erice, Italy "From Genes to Drugs via Crystallography". Hands on course on "Molecular Docking with Northwestern DOCK", May 23 – June 2 2002.
6. International Conference on Computational Nanoscience and Nanotechnology, ICCN 2002, April 21-25, Puerto Rico "Molecular Docking and Drug Design."
5. Booth, poster and lecture at the International Union of Crystallography, August 1999. "The Macromolecular Structure Database Project at the European Bioinformatics Institute."
4. Poster and lecture at Erice, Sicily, Italy. May 1999. The Macromolecular Structure Database Project at the European Bioinformatics Institute.
3. University of Cambridge, Department of Haematology April 1999. "The Design and Use of the Protein Data Bank."
2. Tutorial instructor at the International Union of Crystallography Summer School held in Bellingham, WA, USA, August 1996.
1. Tutorial instructor and speaker, Multiple Anomalous Dispersion (MAD) Workshop held at the European Synchrotron Radiation Facility (ESRF) in Grenoble, France - June 1996.

National (15)

15. American Chemical Society National Meeting, Philadelphia PA, August 2008, "Quantitatively relating proteins by their ligands".
14. Invited seminar at the eChemInfo October 2008 meeting in Philadelphia. "Community benchmarks for virtual screening"
13. MedChemUSA 2007, Boston MA, October 2007, "How good is your virtual screening library?" – Keynote presentation.

12. American Chemical Society National Meeting, Boston MA, August 2007, “Benchmarking sets for molecular docking.”
11. American Chemical Society National Meeting, Boston MA, August 2007. “Relating protein pharmacology by ligand chemistry.”
10. American Association of Cancer Research –American Chemical Society Joint Meeting, San Diego, Feb 4-7, 2007, “ZINC: A public access library for HTS and virtual screening
9. Invited speaker at the eChemInfo 2006 meeting in Philadelphia on Structure based drug design (October 2006). “Investigating bias in docking screens with target, ligand and decoy benchmarking sets”
8. Invited speaker on Virtual Screening and Drug Design at the 46th Sanibel symposium, St. Simmons Island, Georgia Feb 25 2006.
7. Invited seminar at the eChemInfo 2005 meeting in Philadelphia on Web-based Services in Drug Design (October 11-13, 2005). “Web-based Cheminformatics services from the ZINC Database”
6. American Chemical Society National Meeting, Washington DC, Aug 20-Sept 2, 2005. “Public Information Databases for Virtual Screening”
5. American Chemical Society National Meeting, Washington DC, Aug 20 – Sept 2, 2005. “The ZINC Database as a New Research Tool for Ligand Discovery”.
4. Invited seminar at the US Meeting on Chemical Databases, NIH, Washinton DC, July 2005. “The ZINC Database and PubChem – Natural Synergies for Open Access Cheminformatics”
3. Speaker at Cambridge Healthtech Institute’s 4th Annual meeting on Structure Based Drug Design, Boston, MA April 26-27, 2004. “ZINC: A free database of commercially available compounds for virtual screening.”
2. Speaker at the Amercian Association for Cancer Research Annual Meeting, Orlando FL, March 27-31, 2004. “An automatic virtual screening system.”
1. American Crystallographic Association Annual Meeting, Montreal Canada, August 1995, A graphical interface for BUSTER, a phasing and refinement program for macromolecular structure determination.

Seminars in the USA (8)

8. Department of Biological Sciences, Louisiana State University, Baton Rouge LA, March 31, 2008, “What can I expect from a virtual screening campaign?”
7. University of New Mexico School of Medicine, Biocomputing Day, March 28, 2008. “Quantitatively relating proteins by their ligands.”
6. Cup IX, The OpenEye User’s meeting. Invited presentation. March 2008. “DOCK Blaster: a free virtual screening facility”
5. College of Pharmacy, University of Minnesota, Minneapolis MN. January 23, 2007, “In virtual screening, you are only as good as your library.”

4. University of Arkansas, Department of Chemistry and Biochemistry. May 17, 2004. "Virtual screening against metalloenzymes."
3. National Center for Biotechnology Information (NCBI/NLM/NIH), Washington, D.C., April 8 2004. "A Free Database of Commercially Available Compounds for Virtual Screening."
2. Virtual lecture on the e-Cheminfo hub, <http://conferences.metalayer.net>, March 15, 2004 "An automatic virtual screening system".
1. Pharmacia Corp, Kalamazoo MI, Sept 2002. "Recent advances in molecular docking."

US Government Service

2005-7 Reviewer for the National Science Foundation.

2006 Reviewer for the Hypersensitivity, Autoimmunity and Immune-mediated Diseases Study Section

University and Public Service

UCSF Committee Service

Oct 2005 – Aug 2007 School of Pharmacy Admissions Committee

Teaching Experience

Graduate Education & Courses

UCSF

2004-2008 *BP206. Molecular docking* (Jacobson) (4 hours, Spring Quarter – 9-12 students)

Pharmacy Education & Courses

2004-2006, 2008 *PC152 Drug Discovery* (4 hours, Winter Q, 8-12 students) [not held in 2007]

Visiting Scholars Trained in Structure Based Drug Design using Docking (9)

07/15/00 to 07/31/00	Toni Dow (grad student)	Yale University (lab of Prof. Karen Anderson)
2/15/01 to 3/1/2001	Yue Pan (grad student)	Northwestern Univ., Dept. of Chemistry
03/01/01 to 4/31/01	Dr. Anna Vulpetti	Pharmacia Inc, Nerviano Italy
02/15/01 to 03/01/01	Darrell Hurt (grad student)	Cornell University (lab of Prof. John Clardy)
04/02/01 to 04/05/01	Dr. Douglas Rohrer	Pharmacia Inc, Kalamazoo MI
04/16/01 to 04/30/01	Dr. Leo Grinius	Procter & Gamble, Cincinnati OH
01/20/03 to 01/31/03	Dr. Beth Collantes	Pharmacia Inc, St. Louis MO
04/01/05 to 05/11/06	Dr. Miyuki Shoda	Asahi Corporation, Japan
02/01/08 to 08/01/08	Francesco Colizzi	University of Bologna, Italy.

Trainees in Molecular Docking Methods (6)

Graduate Student Research Rotations (Northwestern University)

2001	Austin Kirschner (MSTP)
2002	Alan Graves (IBiS)

2002 Brian Feng (IGP/CCB)
Graduate Student Research Rotations – Training (UCSF)
2004 Mori Feldman
2004 Abram Calderone
2005 Mike Keiser

Scientific Advisory Boards & Consulting

2002 Consultant for Pharmacia Corp., Kalamazoo MI
2004-2007 Scientific Advisory Board for eChemInformatics 2004, a Cheminformatics Virtual Conference. <http://conferences.metalayer.net/echeminfo/>, Zurich, Switzerland
2005 Consultant for Elan Pharmaceuticals, South San Francisco CA
2006- Editorial Advisory Board and Section Editor, BMC Chemistry Central Journal

Research and Creative Activities

Research Grants/Contracts

Active (Total Direct Cost)

National Institutes of Health (Shoichet, B.K., PI) R01 GM71896 8/1/04 – 7/31/07
An automated web-based molecular docking system \$670,000
I am co-investigator on this grant.

Patents (1)

1. Howard L, Miller S, Shoichet BK, **Irwin JJ**, US 2007/0041981 (Feb 22, 2007). Compositions and Methods for Altering Immune Function

Scholarly Productivity

Peer Reviewed Journal Articles (15 total)

15. Hert J, Keiser M, Irwin JJ, Oprea TI and Shoichet BK, Quantifying the relationships among drug classes, *J. Chem Inf Mod* (2008), ASAP.
14. Babaoglu, B, Simeonov, A, **Irwin JJ**, Nelson ME, Feng B, Thomas CJ, Cancian L, Costi MP, Maltby DA, Jadhav A, Inglese J, Austin CP and Shoichet BK, A comprehensive mechanistic analysis of hits from high throughput and docking screens against beta lactamase, *J. Med. Chem.* (2008), ASAP.
13. Keiser MJ, Roth BL, Armbruster BN, Ernsberger P, **Irwin JJ*** and Shoichet BK*, Relating protein pharmacology by ligand chemistry, *Nature Biotechnology* (2007), 25(2), 197-206.
12. Hermann JC, Gahanem, E, Li Y, Raushel FM, **Irwin JJ*** and Shoichet BK, Predicting Substrates by Docking High-Energy Intermediates to Enzyme Structures, *J. Am. Chem. Soc.* 128(49), 15882-91 (2006).

11. Huang N, Shoichet BK*, **Irwin JJ***, Benchmarking sets for Molecular Docking, *J. Med. Chem.*, **49**(23), 6789-6801 (2006).
10. Huang N, Kalyanaraman C, **Irwin JJ** and Jacobson MP, Physics-based scoring of protein-ligand complexes: enrichment of known inhibitors in large-scale virtual screening, *J. Chem. Inf. Model*, **46**(1), 243-53 (2006)
9. Brenk R, **Irwin JJ**[‡] and Shoichet BK, Here be dragons: docking and screening in an uncharted region of chemical space. *J Biomol Screen*, **10**(7), 667-74 (2005). [‡] Denotes co-first author
8. **Irwin JJ**, Raushel FM and Shoichet BK, Virtual Screening against metalloenzymes for inhibitors and substrates, *Biochemistry*, **44**(37), 12316-28 (2005)
7. **Irwin JJ** and Shoichet BK, ZINC: A database of commercially available compounds for virtual screening., *J. Chem. Inf. Model*, **45** (1), 177-8 (2005).
6. Atreya CE, Johnson EF, Irwin JJ, Dow A, Massimime KM, Coppens I, Stempliuk V, Beverley S, Joiner KA, Shoichet BK, Anderson KS, A molecular docking strategy identifies Eosin B as a non-active site inhibitor or protozoal bifunctional thymidylate synthase-dihydrofolate reductase, *J. Biol. Chem.*, **278**(16), 14092-100 (2003)
5. Roversi P, **Irwin JJ** and Bricogne G. "Accurate charge density studies as an extension of Bayesian crystal structure determination". *Acta Crystallographica A*54, Part 6, Number 1 , 971-996, (1998).
4. Weston SA, Camble R, Colls J, Rosenbrock G, Taylor I, Egerton M, Tucker AD, Tunnicliffe A, Mistry A, Mancina F, de la Fortelle E, **Irwin J**, Bricogne G, Pauptit RA. Crystal structure of the anti-fungal target N-myristoyl transferase. *Nat Struct Biol*. 1998 Mar;5(3):213-21.
3. **Irwin JJ**, Ha T-K, Dunitz JD, "Stereochemical Aspects of the Anomeric Effect in Fluoromethylamine", *Helv. Chim. Acta*, 1990, 73, 1805-1817.
2. Burrow T, **Irwin JJ** and Farrar DH, "Computer Modelling of Steric Effects in Organometallic Chemistry," *Inorg. Chim Acta*, 1991, 181, 65-72.
1. Bogdan PL, **Irwin JJ**, and Bosnich B, "Asymmetric Synthesis. Molecular Graphics and Enantioselection in Asymmetric Catalytic Hydrogenation," *Organometallics*, 1989, 8, 1450-1453.

Non-peer reviewed publications and other creative activities

Review Articles (5 total)

5. **Irwin JJ**, Community benchmarks for virtual screening, *J Comput Aided Mol Des* (2008), available online.
4. Sturla SJ, **Irwin JJ**, Loepky RN, Mulvihill MJ and Searcey M, Chemistry in cancer research: a vital partnership., *ACS Chem Biol*. (2007), 2(5) 286-92.

3. Sturla SJ, **Irwin JJ**, Loeppky RN, Mulvihill MJ and Searcey M, Chemistry in cancer research: a vital partnership., *Cancer Res.* (2007), 67(14) 6539-43. This is a duplicate of #4, over which I had no control, included for completeness.
2. **Irwin J.J.**, How good is your screening library?, *Curr. Op. Chem. Biol.* (2006) 10 (4), 352-6.
1. Shoichet, B.K.*, McGovern, S.L., Wei, B., **Irwin, J.J.** Lead Discovery Using Molecular Docking. *Current Opinion in Chemical Biology*, **6**, 439-446 (2002).

Book Chapters (9 total)

9. **Irwin JJ** in *Current Protocols in Bioinformatics* edited by Baxevanis AD and Davison DB, Wiley, New York (2007). "The ZINC database of commercially available compounds for virtual screening."
8. **Irwin, JJ.** & de La Fortelle, E. in *Direct Methods for Solving Macromolecular Structures* edited by S. Fortier. Kluwer Academic Publishers, The Netherlands (1998). "An Integrated Graphical User Interface for Crystallographic Software"
7. **Irwin, JJ.** and LaFortelle, E. de, "An integrated graphical user interface for crystallographic software", in *Direct Methods for Solving Macromolecular Structures*, Suzanne Fortier (ed.), NATO ASI Series C: Mathematical and Physical Sciences - Vol. 507, Kluwer Academic Publishers, 1998 pp. 181-187.
6. Roversi P., **Irwin, JJ.** and Bricogne G. Maximum Entropy charge density studies: Bayesian viewpoint and test applications, in "Charge, Spin and Momentum Densities and Chemical Reactivity", P. Mezey and B. Robertson, ed.s. Series: "Understanding Chemical Reactivity". Kluwer Academic Press (1998)
5. LaFortelle, E. de, **Irwin, JJ.** & Bricogne, G. (1997). "SHARP: A Maximum-Likelihood Heavy-Atom Parameter Refinement Program for the MIR and MAD Methods." In *Recent Advances in Phasing*, edited by K. Wilson & E.J. Dodson. Warrington: Daresbury Laboratory.
4. **Irwin, JJ.** and Bricogne G. (1998). "Maximum-Likelihood Refinement of Incomplete Models with BUSTER and TNT." In *Crystallographic Computing 7*, edited by P.E. Bourne & K.D. Watenpaugh. Oxford: Clarendon Press.
3. La Fortelle, E. de, **Irwin, JJ.** & Bricogne, G., (1998) *Crystallographic Computing 7*, edited by Philip Bourne and Keith Watenpaugh. "SHARP: A Maximum-Likelihood Heavy-Atom Parameter Refinement and Phasing Program for the MIR and MAD Methods." Oxford: Clarendon Press.
2. Roversi P, **Irwin JJ** and Bricogne G. "A Bayesian Approach to High-Resolution X-ray Crystallography: Accurate Electron Density Studies with Program BUSTER". IUCr XVII Congress and General Assembly, Collected Abstracts MS09.01.06, Seattle, Washington, USA (1996).
1. Bricogne, G. and **Irwin, JJ.** (1996). "Maximum-Likelihood Structure Refinement: Theory and Implementation with BUSTER + TNT." In *Macromolecular Refinement*, Proceedings of the Study

Weekend held at Daresbury Laboratory, 5-6 January 1996, edited by E.J. Dodson, M. Moore, A. Ralph, & S., pp. 85-92.

Web sites and services

I created and maintain the ZINC database of commercially available compounds for virtual screening. <http://zinc.docking.org>. This database went live in January 2004 and has been searched, accessed and downloaded by more than 5000 sites as of May 2006 including most major pharmaceutical companies, biotech companies and universities. It continues to be used regularly and intensively by labs across the USA and all over the world.

I co-created and curate the DUD website, offering a “directory of universal decoys” for benchmarking virtual screening. This has been available for free to the community on our website, <http://blaster.docking.org/dud/>, since July 2006.

I created and maintain the DOCK Blaster website, a free virtual screening service. This system has been available to the public since Jan 2008, and has been used by over 50 different investigators since its debut in 2003.

Other Creative Activities

I created and produce a virtual course of the International School of Crystallography. We stream lectures from this international meeting live on the internet, making the lectures available on-line and on DVD after the meeting as an educational resource. These educational lectures are consulted by hundreds of scientists worldwide.

2003 – High Pressure Crystallography – <http://erice2003.docking.org>

2004 – Polymorphism – <http://erice2004.docking.org/vcourse/polymorph/>

2004 – Electron Crystallography – <http://erice2004.docking.org/vcourse/elcryst/>

2005 – Evolving Methods for Macromolecular Crystallography <http://erice2005.docking.org>

2006 – Structure and Function of Large Molecular Assemblies <http://erice2006.docking.org>

2007 – Engineering of Crystalline Materials Properties <http://erice2007.docking.org>. not public.

Forthcoming meetings:

2008 – From Molecules to Medicine - Integrating Crystallography (Drug Design)

<http://erice2008.docking.org>

Conferences & Sessions Organized

I have been a full member of the local organizing committee of the International School of Crystallography since 1998. Together with the two other local organizers, I have run the following meetings:

1998 *Molecule and Material Structures for New Technologies*
International School of Crystallography, Erice, Italy

- 1999 *Crystal Engineering*
International School of Crystallography, Erice, Italy
- 1999 *Data Mining in Crystallography*
International School of Crystallography, Erice, Italy.
- 2000 *Crystallography of Molecular Biology*
International School of Crystallography, Erice, Italy
- 2001 *Strength from Weakness – Intermolecular Interactions in Crystallography,*
International School of Crystallography, Erice, Italy
- 2002 *From Genes to Drugs via Crystallography*
International School of Crystallography, Erice, Italy
- 2003 *High Pressure Crystallography*
International School of Crystallography, Erice, Italy.
- 2004 *Diversity amidst Similarity – Polymorphism in Crystallography*
International School of Crystallography, Erice, Italy
- 2004 *Electron Crystallography*
International School of Crystallography, Erice, Italy.
- 2005 *Methods in Macromolecular Crystallography*
International School of Crystallography, Erice, Italy.
- 2006 *Structure and Function of Large Molecular Assemblies*
International School of Crystallography, Erice, Italy.
- 2007 *Engineering of Crystalline Materials Properties,*
International School of Crystallography, Erice, Italy.
- 2008 *From molecules to medicine – Integrating Crystallography,*
International School of Crystallography, Erice, Italy.